

NOTES ON STAUROPHLEBIA RETICULATA BURM.

BY E. M. WALKER, TORONTO.

Mr. E. B. Williamson, of Bluffton, Ind., recently placed in my hands for study a series of the large Aeshnine dragonfly, *Staurophlebia reticulata* Burm., taken by himself, his father (the late Mr. L. A. Williamson) and Mr. B. J. Rainey in four localities, viz., Los Amates, Guatemala; Baracon, Chaquamas, Trinidad; Rockstone, British Guiana, and Tumatumari, British Guiana.

On handing over the series to me, Mr. Williamson called my attention to the marked difference in coloration between the British Guiana specimens and those from the other localities, and stated that this difference was much more conspicuous in the living insects, being readily recognizable during flight. It seemed, therefore, desirable to make a careful study of the material in order to determine, if possible, the systematic status of the two colour-forms.

While pursuing this object, I have also taken the opportunity of studying the mutual adaptation between the peculiarly specialized structure of the male abdominal appendages and the correlated parts of the head and prothorax of the female, which are held by these appendages during copulation; especially in view of Mr. Williamson's observations on the habits of this species during the copulatory act (*vide inf.*)

Coloration.

On the envelope containing one of the males from Rockstone, British Guiana, is the following field-note: "Thorax and head bright grass green, segments 1 and 2 similar, shading into yellowish; 3-9 golden-brown, clearest on each segment anterior to transverse carina; posterior to transverse carina shaded into brown; 10 largely yellow."

With one of the Trinidad specimens is the following note:—

"Colours like British Guiana specimens, but abdomen distinctly bluish-green, very different from British Guiana specimens, so much so that colours in flight are very different."

The Guatemala specimen bears the following note:—

"Eyes bright green, face greenish-blue, thorax dull green, abdomen after transverse carina on 3 dull blue."

The colour-characters of the males as seen in the dried specimens may be tabulated as follows:—

BRITISH GUIANA	TRINIDAD	GUATEMALA
Face grass green.	Face grey-bluish green.	Face grayish olivaceous.
T-spot, with distinct narrow stem.	T-spot with distinct narrow stem.	T-spot reduced to a narrow streak along frontal margin, no stem.
A dark brown line on fronto-nasal suture and base of labrum.	A dark brown line on fronto-nasal suture, sometimes faint and base of labrum.	Such lines not distinctly present.
Thorax grass-green, a chocolate streak in front of antearlar sinus and extending along base of mid-dorsal carina.	Thorax of a darker and colder or more bluish-green with similar markings.	Thorax dark reddish-brown, with a dull greenish bloom (dull green in life), scarcely darkened in front of antearlar sinus and base of median carina.
Green colour of thorax extending on abdomen not beyond sides of seg. 1, shading into ochre yellow on 2 and base of 3, posterior to which abdomen is orange-brown, darker on each segment behind transverse carina (golden-brown in life).	Green colour of thorax extending on abdomen to transverse carina on 2, distal part of 2 and 3 front of transverse carina reddish-brown, shading into dark-greenish brown on the remaining segments (bluish-green in life).	Abd. segs. 1 and 2 apparently concolorous with thorax. Seg. 3 anterior to transverse carina clear reddish-brown, shading into dull dark greenish-brown in the remaining segs. (dull blue in life).

The females in the dried condition are similar in colour to the males from the same localities. In those from Trinidad the brown line on the fronto-nasal suture is faint, as it is in some of the males.

STRUCTURAL CHARACTERS.

A careful search was made for structural characters particularly in the genitalia of both sexes, the abdominal appendages of the male and the wing-venation. The results were entirely negative, except in the venation, and even here no constant differentials were found, nor anything approaching such characters. All that could be detected was the presence of slight differences in the average number of certain cross-veins, cells, etc., as shown in the table below. Only the males from British Guiana and Trinidad were in sufficiently large series to be used for this purpose.

In this analysis the following characters were specially noted and tabulated:—

1. Number of first antecubital veins.
2. Number of first postcubital veins.
3. Number of cubital cross-veins.
4. Number of cross-veins in the triangle.
5. Number of cross-veins in the supratriangle.
6. Number of marginal cells between Rs and M₃.

7. Number of irregular postcubital cells just beyond nodus; i.e., those formed by the apparent prolongation of the subcosta.

8. Number of cells in the anal loop.

9. Number of cells covered by pterostigma.

10. Maximum number of rows of cells between Rs and Rspl.

11. Maximum number of rows of cells between Ms and Mspl.

12. Position of origin of Mia in relation to first postcubital cells.

13. Position of fork of Rs in relation to first postcubital cells.

The results from 7, 9, 10, 11 and 12 were negative. Those of the other numbers are given in the following table:—

Antecubital Veins			Postcubital Veins			Marginal Cells between Rs and M3			Cross-veins in triangle			Cross-veins in supra-triangle			Position of fork of Rs (No. of cells before stigma)		
No. of v'ns	No. of wings		No. of v'ns	No. of wings		No. of c'ls	No. of wings		No. of v'ns	No. of wings		No. of c'ls	No. of wings		No. of c'ls	No. of wings	
	R.G.	Tr.		R.G.	Tr.		R.G.	Tr.		R.G.	Tr.		R.G.	Tr.		R.G.	Tr.
Fore wings			Fore wings			Fore wings			Fore wings			Fore wings			Fore wings		
24	1	0	19	0	1	36	0	1	4	1	2	6	2	1	5	0	2
25	1	1	20	0	1	37	0	0	5	7	6	7	1	5	6	2	2
26	0	2	21	0	3	38	1	1	6	10	4	8	8	5	7	7	6
27	1	4	22	4	1	39	1	3	7	2	0	9	8	1	8	6	1
28	2	2	23	3	2	40	4	2	Hind wings			10	1	0	9	3	1
29	2	2	24	3	2	41	5	0	3	0	1				10	2	0
30	4	0	25	4	1	42	4	1	4	4	8	Hind wings			Hind wings		
31	6	0	26	4	1	43	3	1	5	12	3	4	0	2	7	1	4
32	1	1	27	1	0	44	0	1	6	4	0	5	3	7	8	3	4
33	1	0				45	1	1				6	13	3	9	8	1
34	1	0							Cubital Cross-veins			7	4	0	10	6	1
Hind wings			Hind wings			Hind wings									11	2	1
17	1	0	21	0	1	33	0	3	Fore wings			Cells in Anal loop					
18	1	1	22	0	1	40	0	1	4	2	0						
19	1	5	23	0	0	41	3	0	5	2	7	12	1	2			
20	4	6	24	4	2	42	3	1	6	13	5	13	2	1			
21	5	0	25	2	3	43	2	0	7	3	0	14	3	4			
22	4	0	26	5	2	44	3	2				15	4	3			
23	4	0	27	4	1	45	3	2	Hind wings			16	9	2			
			28	2	2	46	2	2	3	1	3	17	0	0			
			29	0	0	47	2	0	4	16	9	18	1	0			
			30	2	0	48	1	0	5	3	0						
			31	1	0												

In this table B. G. = British Guiana (Rockstone) and Tr. = Trinidad (Baracon). Ten males from the former locality and six from the latter were studied, so that the total number of fore or hind wings was 20 from British Guiana and 12 from Trinidad.

It will be seen from the table that in nearly every case the prevalent number of veins or cells is slightly greater in the British Guiana specimens than in those from Trinidad. In the former, e.g., the number of antecubital veins most often noted is 31 in the fore wings and 21 in the hind wings, while in Trinidad specimens the corresponding numbers are 27 and 20. Similarly in the case of the postcubital veins, the prevalent numbers for the British Guiana specimens are 22 and 26 for the fore and hind wings, respectively, while for the Trinidad specimens they are 21 and 25. The difference is too slight to be conclusive for any one table, but when taken together the results seem to indicate fairly clearly a slightly greater average complexity of venation in the British Guiana specimens than in those from Trinidad.

The Guatemala specimen is well above the average in complexity of venation, but it is impossible to judge from a single specimen how this form compares with the other two in this regard.

In view of the apparent absence of distinctive structural characters, it is improbable that there is more than one species represented in this series. But there are at least two strikingly different types of coloration characteristic of different localities, and it, therefore, seems best to regard these as geographical races. The Guatemala specimen, not being identical with either of the South American forms may be considered for the present as the type of a third race.

The type locality of Burmeister's *Aeschna reticulata* is Surinam and the British Guiana form may therefore be considered the typical race. This is also suggested by the expression "viridi-flava," which occurs in Burmeister's description quoted below.

Staurophlebia reticulata reticulata (Burm.)

Burmeister's description (Handb. der Ent., 1839, p. 837) is as follows:¹—

"5. *A. reticulata*; viridi-flava, post mortem sæpius fusca, tibiis intus nigris, alarum venis nigris, cellulis fusco-limbatis, Long. 3¼."

1. Kindly quoted for me by Mr. E. B. Williamson.

"♂. cercis foliaceis, in laterè interno basi apiceque gibbiferis s. auritis.

"Aus Surinam, in Sommers Sammlung,"

Staurophlebia magnifica Brauer from Brazil is probably a synonym of this form.

The specimens in the series studied are labeled as follows:—

Rockstone, British Guiana, Feb. 2, 1912, 2 ♂'s; idem, Feb. 12, 1912, 7 ♂'s; idem, Feb. 14, 1912, 4 ♂'s, 2 ♀'s.

Tumatumari, British Guiana, Feb. 9, 1912, 1 ♂.

These specimens measure as follows:—

Males—Length of body, 94.5-100 mm.; of abdomen (including appendages) 73-78 mm.; of hind wing 62-65 mm.

Average measurements of 11 males—Body 96.6 mm.; abdomen 74.8 mm.; hind wing 63.2 mm.

Females (appendages broken in one specimen)—Length of body 92-94 mm.; length of abdomen (excluding appendages) 64-69 mm.; length of hind wing 63-64 mm.; length of appendages 6.5 mm.

***Staurophlebia reticulata obscura*, n. subsp.**

Under this name I include all the specimens in the series from Trinidad. They have been sufficiently characterized above.

These specimens consist of 7 ♂'s and 3 ♀'s from Baracon, Chaquanas, Trinidad, all dated March 7, 1912.

The 6 ♂'s and 2 ♀'s examined measure as follows:—

Males—Length of body, 92-98 mm.; of abdomen (including appendages) 71-76.5 mm.; of hind wing, 60-66.5 mm.

Average measurements of 6 ♂'s—body 94.4 mm.; abdomen 73.5 mm.; hind wing 63.5 mm.

Females—Length of body 88.5-97 mm.; of abdomen (excluding appendages) 63-68.5 mm.; hind wing 65.5-71 mm.; appendages 6.5-7 mm.

***Staurophlebia reticulata guatemalteca*, n. subsp.**

The single specimen of this form examined is a male from Los Amates, Guatemala, taken by Mr. Williamson, on June 21, 1909. It may not represent a valid race, but cannot properly be placed with either of the other two.

The specimen measures as follows:—

Length of body 99 mm.; of abdomen (including appendages) 76 mm.; of hind wing 67.5 mm.

MUTUAL ADAPTATION OF THE SEXES.

I have noted elsewhere* that in *Aeshna constricta* and its allies the abdominal appendages of the male are specialized for a firmer grasp of the head and prothorax of the female than in those species in which these structures have their usual form, and that these modifications are probably correlated with the more erratic nuptial flight of the species of this group. In *Staurophlebia* the general form of the male superior appendages recalls that of *Aeshna constricta*, but is still more highly specialized, having in addition to a very prominent subapical denticulate crest formed by the extreme elevation of the distal part of the superior carina, and the bending upwards of the margin at its termination, a process from the dorsal surface and supero-external margin, just before the middle, directed horizontally inwards and slightly decurved at apex (pl. XVII., fig. 1h). The inferior appendage is also complicated by the presence of a prominent elevation rising almost perpendicularly from the superior surface of the appendage at its extreme base (fig. 1, b. inf.).

The appearance of these appendages suggests a very firm union between the two sexes during copulation, and it is therefore of interest to learn from Mr. Williamson's notes that the nuptial flight is very erratic.

I relaxed the separated abdomen of a male and the head and thorax of a female, and endeavoured to determine the exact nature of this union. This was an easy matter as far as the head of the female was concerned, but with regard to the prothorax, much careful manipulation was necessary. I think, however, the following account will prove substantially correct.

By applying the upper surface of the inferior appendage to the front of the head in the usual position for the Aeshninae the basal elevation was found to fit accurately in a depression on the rear surface of the female's head just below the occipital margin (fig. 1, b. inf.). This feature alone must render the grasp of the male firmer than in those species which lack the prominence. The superior appendages also fell naturally into position at the rear of the head on the slope of the concavity surrounding the occipital foramen, from which their inner margins were but narrowly

*1912, Walker, E. M., Univ. Tor. Stud., Biol. Series 11, pp. 33-42.

separated. In this position they were divergent at an angle of about 35° . The laterally situated apices occupied a position adjacent to the inner surface of the base of the cardo, or first joint of the maxilla (fig. 1, *mx.*).

When the exact position of the prothorax in relation to the head is observed, it will be seen that the posterior margin of the pronotum approximately coincides with the position of the hook-like processes rising from the upper side of the male superior appendages, and there seems little reason to doubt that in copulation these processes hook over the pronotal margin as shown in figs. 1 and 2. The expanded part of the appendages enclose the pronotum, the crest-like elevations of the superior carinae, which are directed inward, passing beneath and completing the pair of claspers. They appear to fit in a deep depression on the side of the pro-epimerum.

Thus the grasp of the male appendages as compared with those of *Aeshna*, etc., is complicated and strengthened by the following specializations of structure:

(a) The basal protuberance of the inferior appendages, serving to support the occipital region of the head.

(b) The hook-like processes of the lateral margins, supporting the hind margin of the pronotum.

(c) The unusual development of the subapical denticulate crest, serving to grasp the neck immediately in front of the pronotum.

NOTES BY E. B. WILLIAMSON.

The first *Staurophlebia* I ever saw came sailing along the railroad track below Los Amates, Guatemala, one sunshiny morning (June 21, 1909) after a heavy night's rain. As he came towards me, I saw him at some distance, a gigantic fellow flying now within a few feet of the ground and now high up in the air, but following the lane or slash made by the railroad through the jungle. As he raised to pass me, the impression was of a dull, dark insect which might be brown or obscure blue or green. To our mutual surprise a despairing, straight backward high-reached sweep of the net overtook him. This was the only specimen I saw in Guatemala during two collecting trips.

On the morning of January 31, 1912, I followed the log-filled stream back of the rest house at Rockstone, British Guiana, for a mile or two. On two occasions I saw for an instant a large brilliant green and golden-brown æschnine which cut across the stream, with only a moment's hesitation above the water. About 1 p.m. my father and I were at the stream, when we saw it again, but this time flying a beat, possibly 75 or 100 feet long. It disappeared over the trees as I approached, and we decided it was some glorified *Anax* to be found at home possibly at some neighbouring pond. The next day father and Mr. Rainey made a search for such a pond, while I again collected on the creek. Their search for a pond was in vain, but they found the home of our shy acquaintance of the day before in a small shallow muddy creek bed, in the woods, and without running water, there being merely pools of greater or less extent.

They saw several specimens, got several fair strokes at the dragonflies and affirmed that in striking from the rear at the dragonflies they were unable to make the net overtake the insect. The next day I visited this creek bed just below the town on the same side of the river. Never have I seen a dragonfly apparently more out of place—the little muddy wet-weather creek, in some places with the jungle crowding it to a scant 2-foot width, with its obscure, leaf-filtered sunlight on dry or damp mud banks and isolated pools of dirty water—and back and forth in this narrow avenue, from shade into sunlight and back into shade again, a great green and golden æschnine which so clearly belonged to the sunny reaches of marsh or lake. After a few futile strokes I caught one, and then another, and *Staurophlebia* does not take its capture tamely or philosophically. They fought, tearing and biting, and attacked the fingers which drew them from the net.

Staurophlebias were seen only rarely elsewhere in British Guiana, and then only along smaller streams. None were seen the two days I collected in Dutch Guiana. On March 7, 1912, Mr. Rainey and I were accompanied by Mr. F. W. Urich to Baracon, Chaquanas, Trinidad. We found the woods near there very dry with the stream beds in many cases without any water. Along such a stream bed we found a dark bluish or greenish dragonfly flying. Till specimens were captured it never occurred to me that

